

# JHH40N120FA2

## *Product Preview*

**1200V/40A FIELD-STOP TRENCH IGBT WITH DIODE**

**Features**

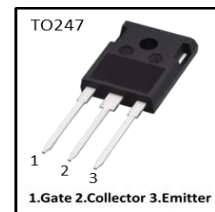
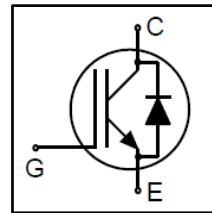
- Low  $V_{CE(sat)}$
- Fast Switching
- High Ruggedness
- Short-Circuit Rated


**Product Summary**

$V_{CES}$	1200V
$I_C$	40A <sup>(1)</sup>
$V_{CE(sat),typ}$	1.75V ( $T_J = 25^\circ\text{C}$ )
Package	TO-247

**Applications**

- Inverters
- Frequency Converters
- Industrial Motor Drives
- Uninterrupted Power Supply


**Ordering Information**

Part Number	Marking	Package	Packaging
JHH40N120FA2	HH40N120FA2	TO-247	Tube

**Absolute Maximum Ratings**

Parameter	Symbol	Limit	Unit
Collector-to-Emitter Voltage	$V_{CES}$	1200	V
Gate-to-Emitter Voltage	$V_{GES}$	$\pm 20$	
DC Collector Current ( $T_c = 25^\circ\text{C}$ , $T_J = 175^\circ\text{C}$ )	$I_C$	61	A
DC Collector Current ( $T_c = 100^\circ\text{C}$ , $T_J = 175^\circ\text{C}$ )		40	
Pulsed Collector Current (pulse width limited by maximum $T_J$ )	$I_{CM}$	160	
Diode Forward Current ( $T_c = 25^\circ\text{C}$ , $T_J = 175^\circ\text{C}$ )	$I_F$	67	
Diode Forward Current ( $T_c = 100^\circ\text{C}$ , $T_J = 175^\circ\text{C}$ )		43	
Diode Pulsed Current (pulse width limited by maximum $T_J$ )	$I_{FM}$	160	
Short Circuit Withstand Time ( $V_{GE} = 15\text{V}$ , $V_{CC} \leq 600\text{V}$ , $T_{J\_start} \leq 175^\circ\text{C}$ )	$t_{SC}$	10	$\mu\text{s}$
Turn-off Safe Operating Area ( $V_{CE} \leq 1200\text{V}$ , $T_J \leq 175^\circ\text{C}$ )	-	160	A
Maximum Power Dissipation ( $T_c = 25^\circ\text{C}$ , $T_J = 175^\circ\text{C}$ )	$P_{D(max)}$	258	W
Operating Junction Temperature	$T_J$	-40 to +175	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-55 to +150	
Maximum Lead Temperature for Soldering (1/8" from case for 5 seconds)	$T_{slid}$	260	

**Static Electrical Characteristics <sup>(2)</sup>**

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Collector-to-Emitter Breakdown Voltage	$BV_{CES}$	$V_{GE} = 0V, I_C = 250\mu A$	1200	-	-	V
Collector-to-Emitter Leakage Current	$I_{CES}$	$V_{CE} = 1200V, V_{GE} = 0V$	-	-	10	$\mu A$
		$V_{CE} = 1200V, V_{GE} = 0V, T_J = 150^\circ C$	-	-	5	mA
		$V_{CE} = 1200V, V_{GE} = 0V, T_J = 175^\circ C$	-	-	20	mA
Gate-to-Emitter Leakage Current	$I_{GES}$	$V_{CE} = 0V, V_{GE} = \pm 20V$	-	-	100	nA
Gate Threshold Voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 1.5mA$	5.5	6.5	7.5	V
Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = 15V, I_C = 40A$	-	1.75	2.1	
		$V_{GE} = 15V, I_C = 40A, T_J = 150^\circ C$	-	2.3	-	
		$V_{GE} = 15V, I_C = 40A, T_J = 175^\circ C$	-	2.45	-	
Diode Forward Voltage	$V_F$	$V_{GE} = 0V, I_F = 40A$	-	2.15	2.6	
		$V_{GE} = 0V, I_F = 40A, T_J = 150^\circ C$	-	2.35	-	
		$V_{GE} = 0V, I_F = 40A, T_J = 175^\circ C$	-	2.25	-	

**Thermal Characteristics**

Parameter	Symbol	Min	Typ	Max	Unit
Junction-to-Ambient Thermal Resistance	$R_{\theta JA}$	-	-	40	$^\circ C/W$
Junction-to-Case Thermal Resistance, IGBT	$R_{\theta JC}$	-	-	0.58	
Junction-to-Case Thermal Resistance, Diode		-	-	0.6	

**Dynamic Electrical Characteristics <sup>(2)</sup>**

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Total Gate Charge	$Q_g$	$V_{CC} = 600V, V_{GE} = 15V, I_C = 40A$	-	148	-	nC
Input Capacitance	$C_{iss}$	$V_{CE} = 25V, V_{GE} = 0V, f = 1MHz$	-	3460	-	pF
Output Capacitance	$C_{oss}$		-	154	-	
Reverse Transfer Capacitance	$C_{rss}$		-	41	-	

**Switching Characteristics, Inductive Load** <sup>(2), (3)</sup>

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Turn-on Delay time	$t_{d(ON)}$	$V_{CC} = 600V,$ $V_{GE} = 0/15V,$ $R_G = 10\Omega,$ $I_C = 40A,$ $L_{load} = 0.82mH,$ Energy losses include "tail" and diode reverse recovery.	-	45	-	ns
Rise Time	$t_r$		-	58	-	
Turn-off Delay time	$t_{d(OFF)}$		-	165	-	
Fall Time	$t_f$		-	110	-	
Turn-On Switching Loss	$E_{on}$		-	2.9	-	mJ
Turn-Off Switching Loss	$E_{off}$		-	1.8	-	
IGBT Total Switching Loss	$E_{ts}$		-	4.7	-	
Diode Reverse-Recovery Time	$t_{rr}$	$V_R = 600V,$ $I_F = 40A,$ $di_F/dt = 672A/\mu s$	-	195	-	ns
Diode Reverse-Recovery Charge	$Q_{rr}$		-	1500	-	nC
Diode Peak Reverse-Recovery Current	$I_{rrm}$		-	18	-	A
Short Circuit Collector Current ( $T_J = 25^\circ C$ )	$I_{C(SC)}$	$V_{GE} = 15V,$ $V_{CC} \leq 600V,$ $t_{SC} \leq 10\mu s$	-	160	-	A

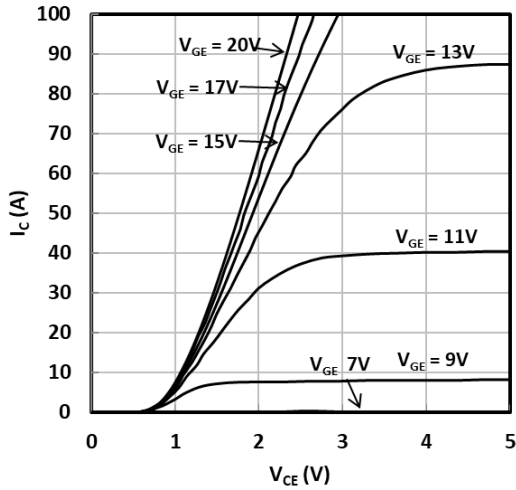
(1) DC collector current,  $T_c = 100^\circ C$ ,  $T_J = 175^\circ C$ .

(2)  $T_J = 25^\circ C$  unless otherwise specified

(3)  $t_r$ : from 10% of  $I_C$  to 90% of  $I_C$ ;  $t_f$ : from 90% of  $I_C$  to 10% of  $I_C$ ;

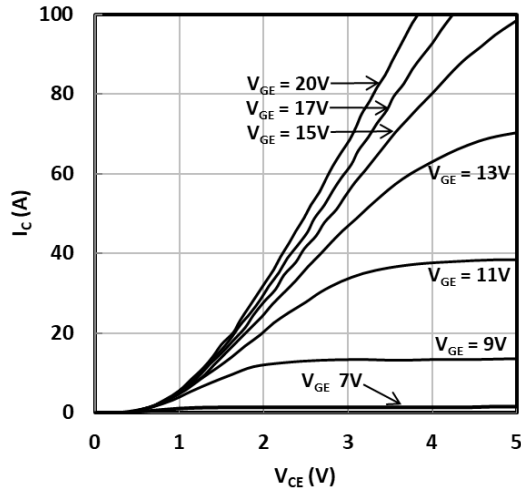
$E_{on}$ : from 10% of  $V_{GE}$  to 10% of  $V_{CE}$ ;  $E_{off}$ : from 90% of  $V_{GE}$  to 10% of  $I_C$ .

**Typical Electrical Characteristics**



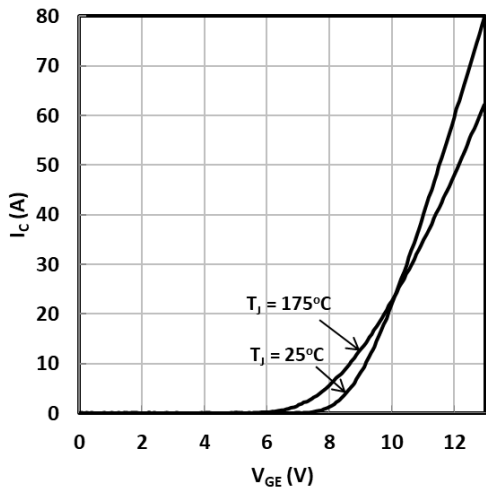
**Fig. 1 Typical output characteristics**

( $T_J = 25\text{ °C}$ ,  $t_p = 250\text{ }\mu\text{s}$ )



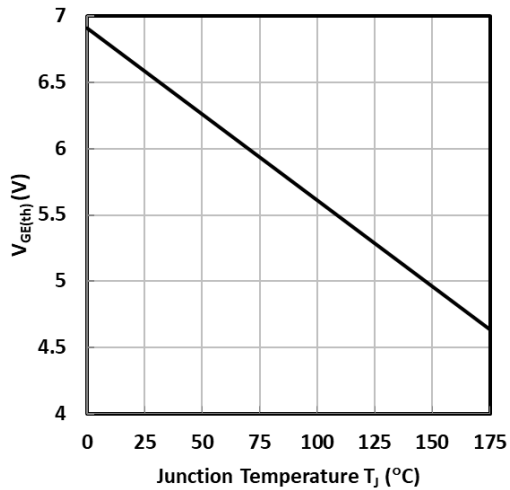
**Fig. 2 Typical output characteristics**

( $T_J = 175\text{ °C}$ ,  $t_p = 250\text{ }\mu\text{s}$ )



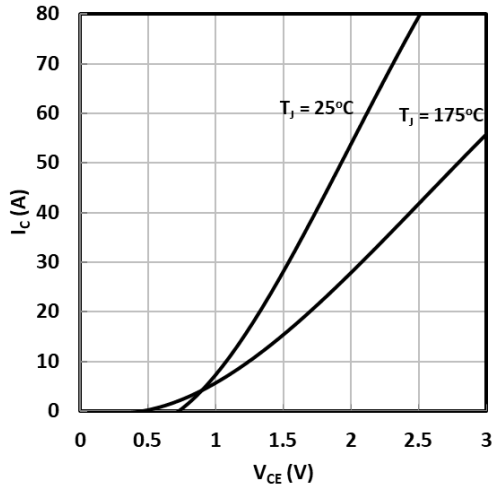
**Fig. 3 Typical transfer characteristics**

( $V_{CE} = 20\text{ V}$ ,  $t_p = 250\text{ }\mu\text{s}$ )

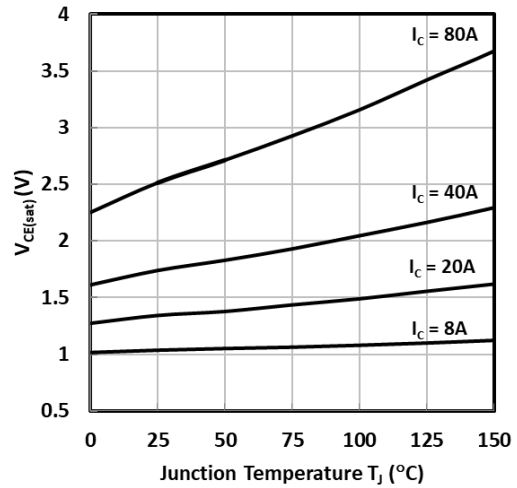


**Fig. 4 Typical gate threshold voltage as a function of junction temperature**

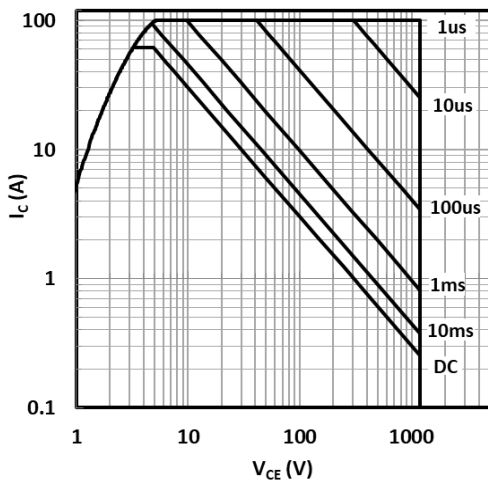
( $V_{CE} = V_{GE}$ ,  $I_C = 1.5\text{ mA}$ )



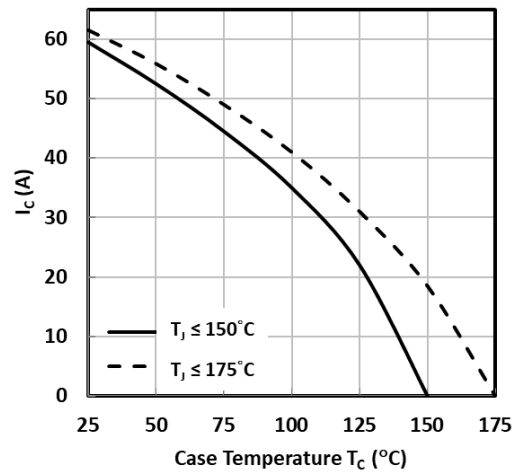
**Fig. 5 Typical saturation voltage characteristics**  
( $V_{GE} = 15\text{ V}$ ,  $t_p = 250\ \mu\text{s}$ )



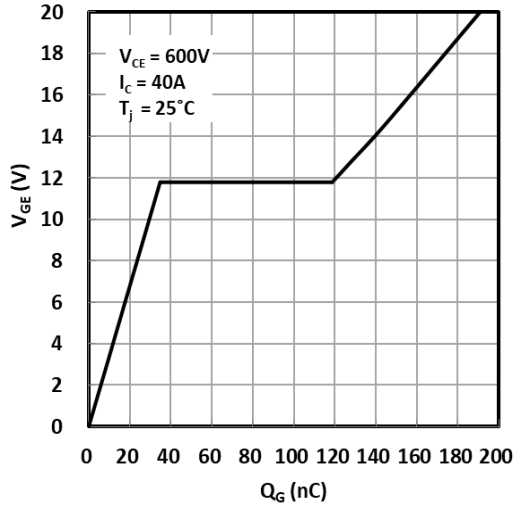
**Fig. 6 Typical saturation voltage as a function of junction temperature**  
( $V_{GE} = 15\text{ V}$ ,  $t_p = 250\ \mu\text{s}$ )



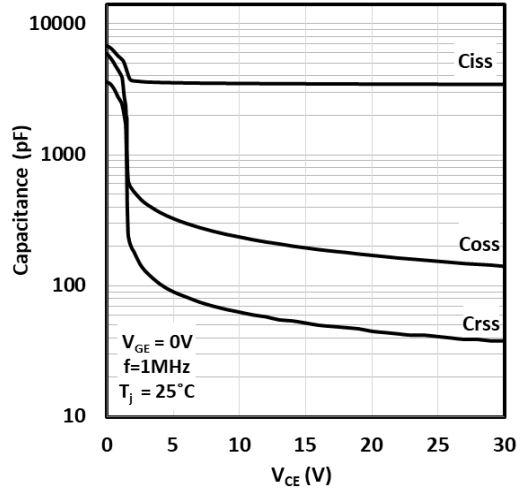
**Fig. 7 Safe operating area**  
( $D = 0$ ,  $T_C = 25\ ^\circ\text{C}$ ,  $V_{GE} = 15\text{ V}$ ,  $T_j \leq 175\ ^\circ\text{C}$ )



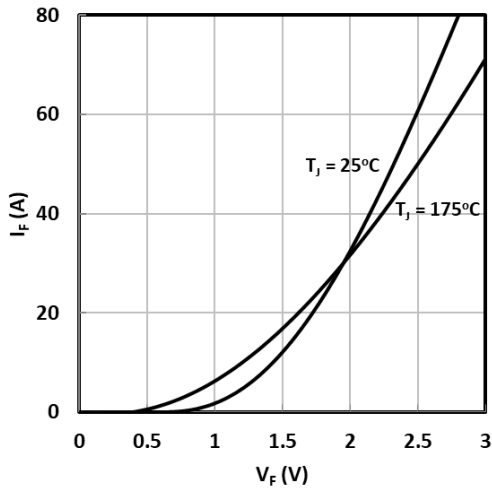
**Fig. 8 Maximum DC collector current as a function of case temperature**



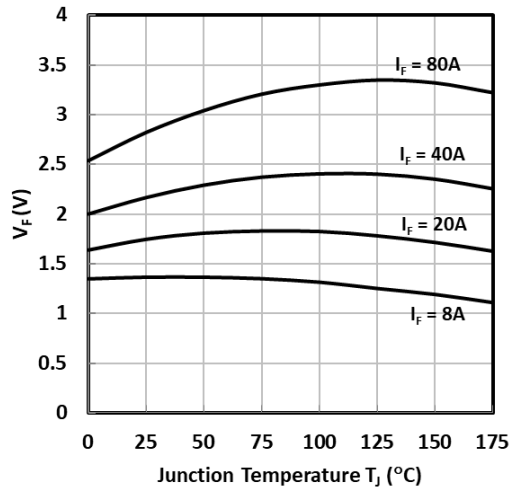
**Fig. 9 Typical gate charge characteristics**



**Fig. 10 Typical capacitance as a function of collector-to-emitter voltage**

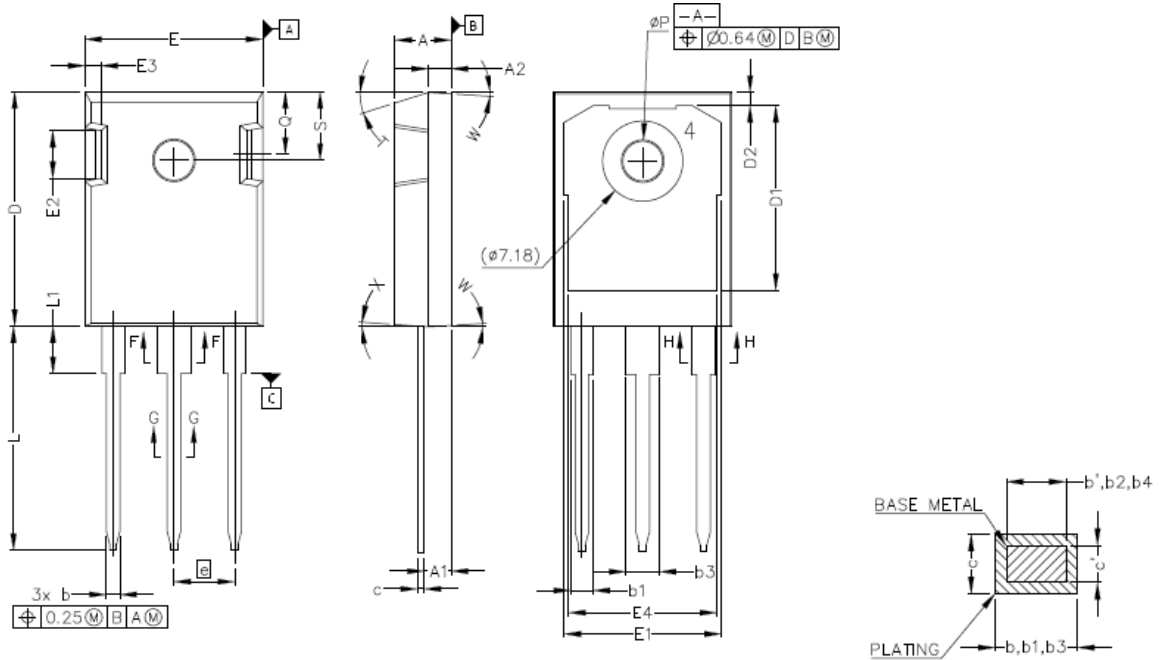


**Fig. 11 Typical diode forward current as a function of forward voltage**  
( $V_{GE} = 0\text{ V}$ ,  $t_p = 250\ \mu\text{s}$ )



**Fig. 12 Typical diode forward voltage as a function of junction temperature**

Package Drawing



SYM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	.190	.205
A1	2.29	2.54	.090	.100
A2	1.91	2.16	.075	.085
b'	1.07	1.28	.042	.050
b	1.07	1.33	.042	.052
b1	1.91	2.41	.075	.095
b2	1.91	2.16	.075	.085
b3	2.87	3.38	.113	.133
b4	2.87	3.13	.113	.123
c'	0.55	0.65	.022	.026
c	0.55	0.68	.022	.027
D	20.80	21.10	.819	.831
D1	16.25	17.65	.640	.695
D2	0.95	1.25	.037	.049
E	15.75	16.13	.620	.635
E1	13.10	14.15	.516	.557
E2	3.68	5.10	.145	.201
E3	1.00	1.90	.039	.075
E4	12.38	13.43	.487	.529
e	5.44 BSC		.214 BSC	
N	3		3	
L	19.81	20.32	.780	.800
L1	4.10	4.40	.161	.173
phi P	3.51	3.65	.138	.144
Q	5.49	6.00	.216	.236
S	6.04	6.30	.238	.248
T	17.5° REF.			
W	3.5° REF.			
X	4° REF.			

TO-247



Revision history of JHH40N120FA2 Specification

Version	Change Items	Effective Date
1.00	Initial Release	17-Jun-20

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